TEXAS AGRICULTURAL EXPERIMENT STATION

BULLETIN NO. 187 MARCH, 1916

DIVISION OF ENTOMOLOGY

Sprays and Spraying

POSTOFFICE:
COLLEGE STATION, BRAZOS COUNTY, TEXAS

AUSTIN, TEXAS
VON BOECKMANN-JONES CO., PRINTERS
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BY

F. B. PADDOCK, B. S. E.

Entomologist in Charge; State Entomologist

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*As of March 1, 1916.
**In cooperation with the United States Department of Agriculture.

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SPRAYS AND SPRAYING.

By F. B. Paddock, B. S. E., Entomologist in Charge; State Entomologist.

INTRODUCTION.

The people of this State are coming to realize more and more every day that if they are successfully to raise their crops to maturity they must combat the many insect pests which are now present. Sooner or later this problem of insect control will present itself to every grower and he must be ready to solve it. Upon the solution of this problem will depend the possible profit or loss in the farm operations. One must know not only *how, what* and *when* to apply, but also when *not* to apply and what *not* to use. It is not sufficient to know that an insect is destroying or even greatly reducing the value of a crop, but one must know the manner in which the insect works and then the general character of the remedy to be used. This may involve a certain knowledge of insects but not the details of exact species or the details of structure.

There is no magic about a spray material. It cannot be applied in a "hit or miss" fashion if satisfactory results are to be obtained. The people of this State have been of the opinion that if they purchased some poison and applied it to the plants in any manner all of the insects would be killed. This practice has led to much disappointment, and some have lost their confidence in the ability of man to eradicate insects. The grower should realize that the use of spray materials is a matter of dollars and cents. Money and time should be used in this work only in such a way as to obtain ample returns from the investment. Hundreds of dollars have been spent in this State in the purchase of spray materials with no benefit at all to the grower. The remedy for such a condition of affairs will only be found when the grower shall become better informed in regard to insect control. Most of the knowledge necessary to do this work in the proper way is to be gained only by observation, for one must learn to recognize conditions as they exist. One cannot expect to follow blindly a "cure-all," and when the results are not satisfactory to lay the blame on the weather.

We have earnestly striven in this bulletin to direct attention to some of the things that are necessary for the growers to consider in attempting to eradicate insects, and to give some means of procedure.

MISTAKES.

Some of the greatest mistakes that are made in spraying for insects may be given as follows:

1. Treatments are often made for troubles which are incurable; consequently no results could possibly be obtained from any operation which might be attempted against them.

2. Treatments are often given where there is no need for them. When first starting to control insects many people get the idea that they must spray even if they do not know whether a pest is present or not.

3. Expensive methods are often used when cheaper ones would serve the purpose equally as well. Even when a cheap method is used, it can be so manipulated that maximum results may be obtained with a minimum expense.

4. The wrong time is chosen to make the application for many insects. It is necessary to understand the general principles of the life history of a pest in order to make timely treatments for it.

5. The improper selection of the material to use against an insect is the most common mistake that is made. As will be clearly shown later, it is not possible to kill *sucking insects* by the use of poison.

6. Too often the grower unknowingly purchases an inferior grade of spray material. The grower must insist on a good grade of spray material since he is paying good money and can rightfully demand the best.

7. The use of a spray outfit not adapted for the particular operation, and the improper use of a good outfit, are the causes of much failure. There are accessories for use with spray outfits that will greatly simplify the operation.

If some of these most common mistakes are guarded against there is no reason why more satisfactory results cannot be obtained in the spraying operations against insect pests. Local experience is really the sure guide for successful spraying operations.

CLASSES OF INSECTS.

The most serious insect pests with which the grower may come in contact can be classed as follows:

1. Biting or chewing insects, those which defoliate or destroy plants.
2. Sucking insects, those which live upon the juices of the plants, causing them to wilt.
3. Boring insects, those which live within the plants.
4. Insects attacking stored products.

BITING INSECTS.

These insects are most often noticed by the casual observer as the destruction which they accomplish is usually very striking. The real injury done by this class of insects depends somewhat upon the time of year that the attack is made on a crop. If the attack is made in the spring, the danger to the crop is much greater than if the attack is not made until fall. This class of insects is the easiest to control since it is possible merely to cover the foliage of plants with a comparatively cheap material with which to poison them. Under certain

conditions the crop may not be valuable enough to warrant the expenditure necessary to purchase a poison, but such cases are very rare. In the case of grasshoppers, which usually appear in hordes over the entire field, it is often a very difficult matter to apply poison enough and fast enough to kill all the hoppers present. The crop may be lost even after the poison has been liberally applied. A mechanical device called a hopperdozer is often very successful in catching great quantities of grasshoppers. Very often it is possible to eradicate a scourge of grasshoppers by the use of this device, in which case it is not necessary to apply any poison. With some insects, as the cutworms, a poisoned bran mash, or similar material, used as a bait, gives far better results than the application of the poison to the plants that are being eaten. This mash is usually so placed as to entice the worms into eating it before they reach the plants.

Sometimes it will be found that measures other than the use of poisons will be of service in combating some pests. Worms that climb the trunks of trees to defoliate them may be stopped in their upward travel by placing bands, such as strips of burlap, around the trunks of the trees. A sticky material, such as tree tanglefoot, is often put around the tree trunks.

One kind of biting insects—the curculios—may be controlled by jarring them from the trees early in the morning.

SUCKING INSECTS.

These insects do their injury to the plants by sucking the juices, which they do by inserting their beaks into the tissue. Therefore it is not possible to eradicate such insects by applying material on the leaves of the plants. It is necessary to use what are called "contact insecticides" to combat this class of insect pests. These sprays are often oily or caustic and produce their effect by stopping up the breathing pores of the insects. The spray must be directed toward that portion of the plant where the insects are attached and feeding. With any contact insecticide, the insects must be hit in order to be killed, and even with extreme care it seems impossible to hit every insect that is present. For this reason a single application is seldom enough to eradicate a pest; consequently it is necessary to make two and sometimes three applications of a material.

The soft-bodied insects—as the plant lice—are very easily killed when hit with a spray, but some of the protected insects—as the scales—are very difficult to eradicate. With these it is necessary to use very strong solutions and to make the application when the plants are dormant. Some of the sucking insects fly when disturbed—as the leaf hoppers—and measures other than the application of contact insecticides must be employed. For this purpose one may use a frame that has a sheet stretched over it and on which is spread some sticky material. As they fly, the leaf hoppers will be caught on this frame. Some form of hopperdozer may be used in a similar manner.

The injury to the plants is often considerable, as the sucking insects

usually concentrate upon a certain part, as the growing tip, tender twigs, buds, or seed. The plant is seldom able to overcome such concentrated attacks. Often sucking insects may cause abnormal growth of the plant and are protected in such a growth. The application of a contact insecticide under such conditions does not prove satisfactory.

Some of the sucking insects feed under ground upon the roots of the plant. The attacks of these insects are seldom fatal to the plant, but they greatly reduce the vigor and the plant cannot withstand the attacks of other insects or diseases above ground. The means we now have of eradicating these underground insects are unsatisfactory. They depend upon making the soil unfit for habitation rather than upon the actual killing of the insects.

BORING INSECTS.

These insects cannot be satisfactorily treated after they have entered the plants. Reduction of the injury done by them lies in preventing their entrance into the plants. After the insects are in the plants the best thing to do is to dig them out by means of a sharp chisel. By carefully following the burrow of the insects one will do no new damage to the plants. The wound should be properly treated to prevent the exposed part from decaying. The injury done by these insects is not the food which they consume, but the plant which they attack is usually made unfit for further service.

Many devices are in use to prevent boring insects from entering plants. These fall into two classes: mechanical protectors and repellent washes. The protectors may be wire netting, wrapping paper, or even a mound of dirt. The protectors are not entirely satisfactory, as the insects will often lay their eggs above them. Formulae for repellent washes will be given later in this bulletin. They are not entirely satisfactory, mainly for the reason that rains interfere with their action.

When boring insects attack annual plants the best method to employ is to pull up the infested plants and burn them at once. In this way the insects are destroyed before they complete their growth. Often boring insects attack the roots of annual plants. For such insects there is no satisfactory means of control other than to destroy the plants immediately. To clean up and burn all infested plants will do much to keep these insects in check.

INSECTS ATTACKING STORED PRODUCTS.

These insects work within the individual kernel or grain or below the surface of the pile. They are, therefore, beyond the reach of any material that might be applied to the surface. By means of fumigation it is possible to satisfactorily control this class of insects, as a gas is able to penetrate to their feeding places. The injury done by these insects may be very greatly reduced by cleaning the storage room thoroughly from time to time and burning all the refuse that may have accumulated. These insects live from year to year in the small lots of grain which are often overlooked or neglected.

INSECTICIDES.

Materials which are used to destroy insects are called insecticides. They may be divided into four classes:

1. Poisons—which kill by being eaten and usually contain some form or arsenic; so are often called arsenicals.
2. Contact insecticides—which kill by clogging up the breathing system by suffocation or by a corrosive action on the skin.
3. Repellents—which keep the insects from attacking the plant or animal to which they are applied.
4. Gases—which are used for fumigating.

POISONS.

Poisons are the cheapest form of an insecticide. They are applied to the food of the insects and must be eaten to be effective. It is evident that poisons are effective only against biting insects, and are of no value against the sucking insects, which go beneath the surface of the plant for their food. Nearly all of the poisons are made from arsenic and consequently are termed "arsenicals." The amount of arsenic varies with the different poisons, but the standard for each is set by law. Arsenicals are insoluble in water, and it is necessary constantly to stir a liquid spray to prevent the poison from settling. In some of the arsenicals there is a small quantity of what is termed "water-soluble" arsenic. Such arsenic will readily combine with water, and when such a combination takes place heat is given off. It is in this way that the foliage of plants is burned when such sprays are applied. The poorer grade poisons contain more water-soluble arsenic than the better grades. With those poisons which contain this water-soluble arsenic it is necessary to add lime to prevent or reduce the burning of the foliage. Most of the arsenicals may be used either as a dry or dust spray, or as a liquid spray.

White Arsenic.

This material should never be used as a spray to put on plants, since it severely burns all tissue that it comes in contact with. The only place it can be safely used is in making poisoned baits for grasshoppers and cutworms. It is the cheapest form of poison that can be purchased.

London Purple.

This material is so variable in composition that the results obtained by its use have been very unsatisfactory. It should never be sprayed on any plants since it will severely burn the foliage. It is possible to use this material in the poisoned bran mashes, but it is seldom recommended. The use of London purple has been discontinued for many years in the progressive spraying sections of the country.

Paris Green.

From the beginning of the spraying practice Paris green has been the only material that was generally recommended. However, it has

not given entire satisfaction. When used as a liquid spray it settles very quickly and causes an uneven application. It does not stick well on the foliage, and as it contains a considerable amount of water-soluble arsenic, it may burn the foliage of the plants to which it is applied. As a spray material Paris green has practically gone out of use.

There are many sections of this State where the grower is unable to obtain any poison other than Paris green, but it is to be hoped that the dealers will soon be able to supply the better poison—arsenate of lead.

Liquid Spray.—Never more than one-half pound of Paris green should be used for fifty gallons of water, and when one is spraying tender plants, such as the peach, only one-fourth pound should be used. The Paris green should be thoroughly mixed into a thin paste and then added to the water. This insures a better mixing of the powder and water. To neutralize the action of the water-soluble arsenic it is necessary to add two pounds of good stone lime to every fifty gallons of water.

Under some conditions it is advisable to use a combined spray of a poison with a fungicide. When Paris green is used in combination with Bordeaux mixture, the same amount is required for fifty gallons of Bordeaux as for fifty gallons of water, and it is not necessary to add the lime.

Dry Spray.—For many crops it is not advisable to use a liquid spray. Paris green may be applied as a powder, but it must be diluted with eight to ten times its weight of flour or air-slaked lime, preferably the latter. As it is usually best to apply a dry poison when there is some dew on the plants, and since dew will combine with the water-soluble arsenic, there is certain to be considerable burning of the leaves from the use of this spray upon cotton. The cotton plant is particularly sensitive to burning by Paris green, and for that reason it is not recommended now for use on cotton.

Arsenate of Lead.

This material is now almost universally used as a poison spray. It is possible to make this material at home, but the commercial preparations are to be preferred, as the contents of the product are guaranteed. This poison is available to the grower in two forms—paste and powder. The cost of the powder is somewhat higher than that of the paste, but the cost of the spray made from either is about the same. This poison is far superior to Paris green, as it does not settle so quickly in the spray tank, is much more adhesive to the foliage, and does not burn the plants; so there is no need for the addition of lime to the spray. The action of this poison is somewhat slower than that of Paris green but certainly as effective.

Liquid Spray.—For a liquid spray either the paste or powdered form of arsenate of lead may be used; three pounds of the paste or two pounds of the powder are required for fifty gallons of water. Mix the required

amount of paste or powder into a thin paste before adding to the barrel of water. It is also possible to use this poison with the Bordeaux mixture, the same proportions being used as suggested for water.

Dry Spray.—When a dry spray is desired the powdered arsenate of lead may be used without the addition of any other material. The powdered arsenate of lead is recommended for use on cotton against all chewing insects.

Zinc Arsenite.

This poison is comparatively new, but the results which have been obtained from it thus far indicate that it may be superior to any other poison now on the market. The greatest feature of this poison is that it is very adhesive to the foliage. It is probable that this poison is not generally available in this State.

There are two materials which are poisonous to insects but not to higher animals unless taken in quantities. These are hellebore and pyrethrum or Persian insect powder.

Hellebore.

Hellebore is a white powder made by grinding the roots of the hellebore plant. This powder loses its strength rapidly and must be fresh to be of any value. It may be used as a dry or liquid spray. If a dry spray is desired, mix the hellebore with flour at the rate of one to three pounds, respectively. For a liquid spray use one ounce of hellebore to three gallons of water. As the hellebore loses its poisonous properties quickly, it may be safely applied to fruits and vegetables just before harvest.

Pyrethrum.

Pyrethrum is a yellowish powder made by grinding the dry flowers of the plant. The destructive power of this material is due to an essential oil. It may be used in the same manner as suggested above for hellebore and in the same proportions. This material is also valuable as a spray for fruits and vegetables that are ripening. If one will close up rooms that are infested with flies and mosquitoes and then fill the air with pyrethrum and keep the rooms closed over night, most of the insects will either be killed or stupefied and drop to the floor.

Poisoned Bran Mash for Grasshoppers.

Probably the best poison for this purpose is called the "Kansas Grasshopper Poison." This is made as follows:

Bran	20	pounds.
Paris green, or white arsenic	1	pound.
Syrup	2	quarts.
Lemons	3	
Water	3½	gallons.

To prepare this mash mix the bran and the poison thoroughly in a wash tub while dry. Squeeze the juice of the lemons into the water and chop the pulp and peel into fine bits and add to the mixture. Dissolve the syrup in the water and then wet the bran and poison with the mixture, stirring so as to dampen the mash thoroughly. The amount of water here given is sufficient to properly moisten the bran.

Poisoned Baits for Cutworms.

In addition to the Kansas grasshopper poison, which is successful against cutworms, the following poison mash gives excellent results:

Wheat or rice bran	50 pounds.
Arsenic or Paris green	1 pound.
Molasses	1 quart.
Water to moisten.	

Mix the poison and the bran together dry. Dilute the molasses in a gallon or two of water and add it to the poison. Mix thoroughly and add only enough water to make the mixture moist but not sloppy.

Poisoned baits of clover are often successful against cutworms. For this purpose cut a small quantity of clover or alfalfa and chop this into rather fine bits. Then spread it out and spray with Paris green at the rate of one-fourth pound to twenty gallons of water. After the poison is dry on the clover it is ready to be distributed in small bunches around the base of the plants that are liable to attack by the cutworms. This poisoned clover should be made late in the afternoon and distributed just before dark so that it will be attractive to the worms when they come from their hiding places at night.

Caution.—These particles of clover or alfalfa which have been sprayed will retain the poison for some time. If the worms do not eat this freely it should be collected and burned and not allowed to dry up and blow around where stock and poultry may get it.

Ant Poison.

The following formula is especially valuable against those ants which are attracted to sweets. This formula is best prepared by a druggist:

White arsenic	¼ gram.
Cane sugar	20 grams.
Water	100 c.c.

The arsenic is dissolved in a portion of the water by boiling and the sugar in the remaining portion. The two solutions are then mixed and water is added to make up for the evaporation. Some color of fruit paste should be added to warn of the poisonous nature of this solution. For use this poison may be put in shallow dishes which are placed in the locations frequented by the ants. The use of this poison is not advised where there are small children in the home.

Fly Poison.

Without doubt the best poison for flies was originated by Prof. R. I. Smith. It is as follows:

Milk	1 pint.
Water	1 pint.
Formalin	1 ounce.

This poison will naturally keep indefinitely. It should be placed in shallow dishes and exposed so as to be readily accessible to the flies.

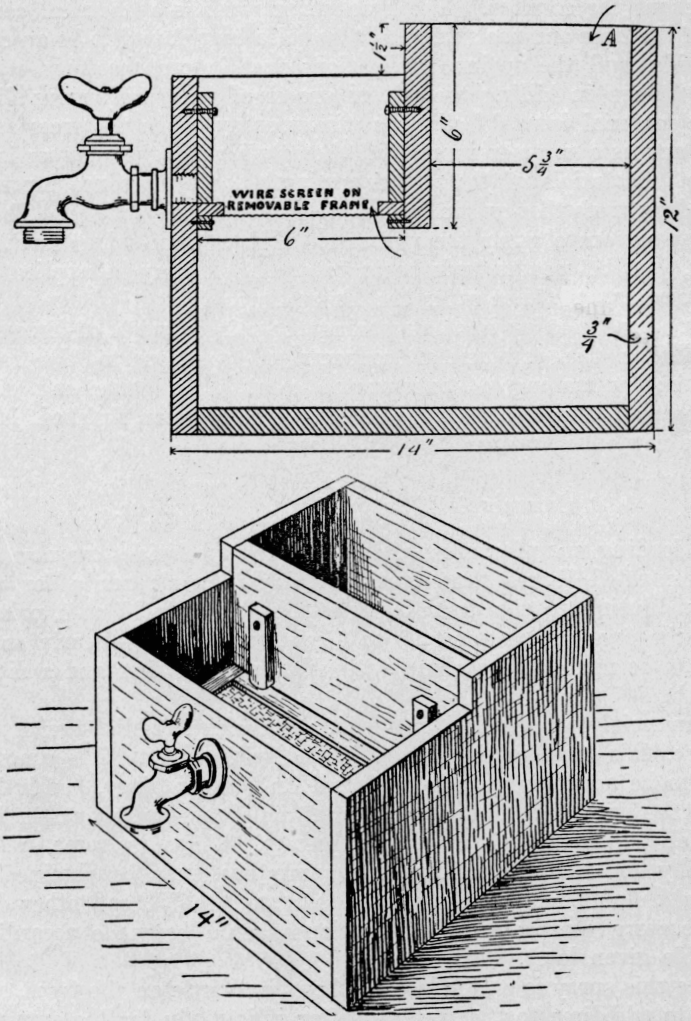

Fig. 1. Stewart's Strainer. The sediment collects below the screen instead of on it, and does not fill up the screen. (Ind. Cir. 34.)

CONTACT INSECTICIDES.

Contact sprays are applied to the insects and only incidentally to the plants. With these the great aim is to apply the material so carefully that it will certainly come in contact with all the insects, as a mere spraying of the foliage is of no value whatever.

Lime-Sulfur Wash.

The lime-sulfur wash has always been the standard remedy for the San Jose scale, and during the last few years has come into wide use throughout the country. The lime-sulfur wash is a chemical combination of the lime and the sulfur. It has also been found to be an efficient fungicide, and the spring applications just before the buds start are very effective in killing the winter spores of various fungous diseases.

The material is used both as a winter spray, when the trees are dormant, and as a summer spray; but the solution for the summer is much weaker. Materials of the proper strength for winter use must never be used on trees that are in leaf, as it will burn the foliage. The most effective season to apply the winter strength of lime-sulfur is the early spring, just before the buds begin to swell. It may be applied in the fall, however, any time after the leaves drop.

There are three ways of preparing the winter wash of lime-sulfur: by diluting the commercial concentrated solution to the required strength; by making a concentrated solution at home and diluting when needed, and by making a solution which, when finished, is ready for use without diluting.

Commercial Concentrated Lime-Sulfur.

The leading manufacturers and dealers in insecticides are now selling a concentrated lime-sulfur solution which is made ready for use by merely diluting to the desired strength. This is sold at a price that makes the final product cost 2½ to 3 cents per gallon,—nearly as cheap as it can be made at home and with the saving of time and a disagreeable job.

Commercial concentrated lime-sulfur is a clear, reddish-brown liquid. For use, this material is simply diluted with water. The amount of water to be added is usually indicated on the container, but it is best to test the strength. This is done with a hydrometer, shown in Figure 2, which will indicate the specific gravity. These hydrometers, made especially for testing the lime-sulfur mixture, may be obtained from Bausch & Lomb Optical Company, Rochester, N. Y., and other dealers in laboratory glassware. The dilutions should be made according to the table given later.

Since this spray is quite clear, it shows but little on the trees. Some prefer to add lime to the material after it is ready for the spray tank, but the lime should be added before the final straining. For this purpose either lump or air-slaked lime may be used, at the rate of six to eight pounds to fifty gallons of the spray. There is no real advantage

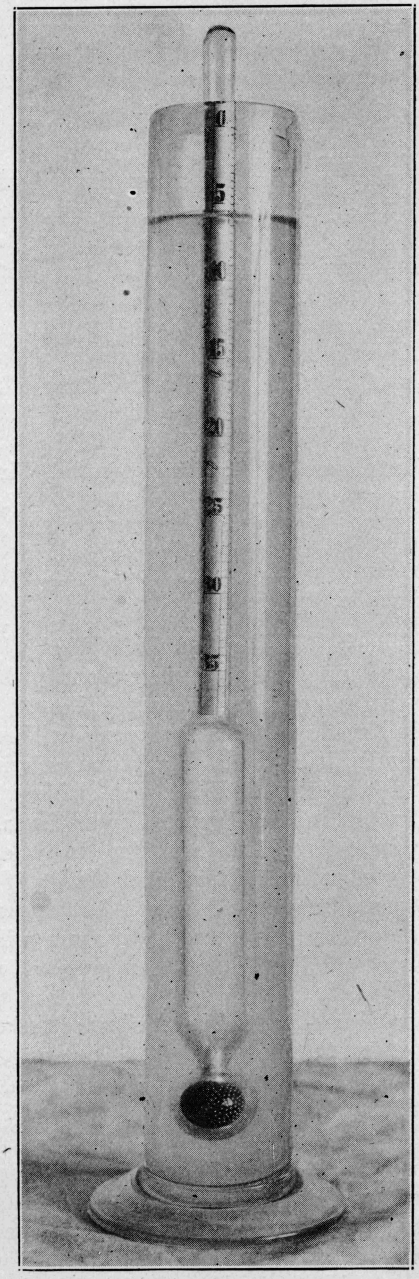

Fig. 2. Outfit for testing density of lime sulfur solution (Ind. Cir. 34).

in adding the lime, but it is easier to tell when the tree has been well coated with the spray.

Home-made Concentrated Lime-Sulfur.

If suitable appliances are at hand it is feasible to make up concentrated lime-sulfur at home, which can be diluted for use when needed. It is absolutely necessary to keep the finished product sealed from the air. It is also essential that the purity of the materials to be used are guaranteed, and it is highly important that only the best grade of lime should be used. Lime which is less than 90 per cent. pure should be discarded. In most cases it will be found that the commercial concentrate is safer to use.

The New York Experiment Station has made extensive experiments on the best methods of making and diluting lime-sulfur, and the following is quoted:

Geneva Station Formula for Concentrated Lime-Sulfur.

Lime, pure	36 pounds.
Lime, 95 per cent. pure	38 pounds.
Lime, 90 per cent. pure	40 pounds.
Sulfur, high grade, finely divided	80 pounds.
Water	50 gallons.

In making, slake the lime in about ten gallons of hot water, adding the lumps slowly so as to avoid too violent boiling. The sulfur must be well moistened and made into an even paste without lumps. Then pour the paste gradually into the slaking lime, stirring constantly to prevent the formation of lumps. When the slaking has finished add the full amount of water and boil gently for an hour. If kettles and fire are used, water must be added from time to time to make up for the loss due to the evaporation. It is much better if the cooking can be done with live steam in a closed vessel, but an open fire will do. When the boiling is done in this way the mixture will be more likely to increase the volume and it will not be necessary to add any water.

Regular Home-made Lime-Sulfur Solution.

Lime (good stone)	20 pounds.
Sulfur	15 pounds.
Water	50 gallons.

This material when finished is of the proper strength for use as a winter spray without any further dilution. It contains much sediment and must always be carefully strained before used.

Place the stone lime in an iron kettle and add a few gallons of hot water; then gradually add the sulfur, which has been made into a paste. Add about twelve gallons of hot water and boil hard for an hour, stirring constantly. Dilute with enough water to make fifty gallons.

DILUTIONS FOR DORMANT AND SUMMER SPRAYING WITH LIME-SULFUR MIXTURES.

Reading on Hydrometer.	Amount of Dilution. Number of Gallons of Water to One Gallon of Lime-Sulfur Solution.		
	For San Jose Scale of Winter Strength.	For Blister Mite.	For Summer Spraying of Apples.
36	9	12½	45
35	8¾	12	43½
34	8½	11½	41½
33	8	11	40
32	7½	10½	37¾
31	7¼	10	36¼
30	6¾	9½	34¼
29	6½	9	32¼
28	6	8½	31
27	5¾	8	29½
26	5½	7½	27¾
25	5	7	26
24	4½	6½	24½
23	4½	6	22¾
22	3¾	5½	21½
21	3½	5	19¾
20	3¼	4¾	18½
19	3	4¼	17

Kerosene Emulsion.

Kerosene emulsion is a very valuable insecticide for the destruction of sucking insects, such as plant-lice, scale-insects, etc., and for the destruction of insects hibernating in rubbish or collected in large masses on tree trunks, etc. Kerosene emulsion is not a poison, but kills by closing up the spiracles or breathing pores of the insects. The ingredients of the emulsion are kerosene, soap, and water in the following proportions:

Laundry soap	1 pound.
Boiling water	1 gallon.
Kerosene	2 gallons.

A low grade of kerosene, which is cheap, is as satisfactory as the higher priced illuminating oil and, if desired, soft soap may be substituted for ordinary laundry soap.

The soap forms a coating around each minute particle of oil, "emulsifying" it and permitting of its then being dissolved or diluted with water. Both the soap and oil are active agents in destruction of the insects.

Preparation.—To prepare the emulsion, shave one pound of laundry soap (or soft soap) into one gallon of *soft* water (rain water). Have the water boiling hot. As soon as the soap is all dissolved *remove the solution from the fire* and add the two gallons of kerosene. At once agitate the material *violently.* Continue for at least five minutes. This is best done by the use of a bucket spray pump; turn the hose or nozzle back into the bucket or tub so that the material is constantly forced vigorously through the pump. In a few minutes a smooth, creamy emulsion is formed, without any free oil. This will get thicker as it cools, but if it is properly made no free oil will separate out. This is

the "stock solution" and will keep indefinitely if sealed from the air. (Do not try to make the emulsion by stirring with a paddle, or similar means, for this does not cause sufficiently violent agitation to thoroughly emulsify the oil.)

Dilution.—For use on trees or shrubs that are *dormant,* the stock solution may be diluted with five to seven parts of water, forming a spray containing 8 to 11 per cent. of oil. On trees or plants that are *in leaf,* one should dilute the stock solution with ten to fifteen parts of water, thus making a spray containing 4 to 6 per cent. of oil. Soft-bodied insects, such as plant-lice, are usually killed with a 5 to 6 per cent. solution. The following table shows how to dilute the stock solution to secure any desired per cent. of oil:

For 4 per cent. strength, add 15⅔ gals. water to 1 gal. stock solution.
For 5 per cent. strength, add 12⅓ gals. water to 1 gal. stock solution.
For 7 per cent. strength, add 8½ gals. water to 1 gal. stock solution.
For 10 per cent. strength, add 5⅔ gals. water to 1 gal. stock solution.
For 12 per cent. strength, add 4½ gals. water to 1 gal. stock solution.
For 15 per cent. strength, add 3½ gals. water to 1 gal. stock solution.
For 20 per cent. strength, add 2⅓ gals. water to 1 gal. stock solution.

Kerosene emulsion is best applied on bright, sunny days when the wind is blowing, since a considerable quantity of the oil will evaporate quickly, and the danger of injury to the plants will thereby be reduced.

Commercial Tobacco Extracts.

There are now on the market highly concentrated extracts of tobacco. For use these liquids are diluted with water according to the concentration of the brand and the insect which is to be killed. Usually the tobacco sprays will spread more readily and evenly on the plants if soap is added to the solution at the rate of one pound to fifty gallons. It has been found that strong tobacco sprays may kill the eggs of some plant-lice. The weaker dilutions of tobacco extracts are especially valuable for destroying soft-bodied insects, as plant-lice. "Black Leaf 40," "Nico-Fume," "Sulphate of Nicotine," and "Black Leaf Extract," are some of the trade names for the tobacco extracts. The cost of these extracts may seem prohibitive, but when diluted the spray is not any more expensive than other materials for the same purpose.

Home-made Tobacco Extract.

It is possible to make an extract at home from the tobacco stems or dust. Place one pound of the stems or dust in one gallon of water and heat to just the boiling point for one hour, making up for any loss of water. This solution should never be allowed to actually boil, as some of the active principles will be lost in the vapors. Dilute this mixture with two parts of water and add soap at the rate of one pound to fifty gallons of spray.

Whale Oil Soap.

Whale oil or fish oil soap is commonly found for sale in the hard form, made from caustic soda. The potash soaps are much to be preferred, as they dissolve more readily in water. This soap solution is especially valuable for use against soft-bodied sucking insects, but it is not generally effective against the more resistant sucking insects. For plant-lice, dissolve this soap in water at the rate of one pound to seven gallons. The hard soap must be shaved into a small quantity of boiling water and the mixture stirred for some time. After the soap has been dissolved, cold water may be added to make the above formula.

Laundry Soap.

If whale oil soap is not available it will be found that a simple solution of laundry soap is very effective for spraying plant-lice. Any good grade of laundry soap may be used for this purpose. The formula of one pound to seven gallons of water has proven very effective against plant-lice. Laundry soap does not dissolve readily, and it is best to shave it into a liberal quantity of boiling water and stir frequently. When the dissolution of the soap is complete, cold water may be added to make the above formula.

Sulfur.

Dry sulfur or powdered sulfur, sometimes called flowers of sulfur, is often used as a contact insecticide, especially against the red spider. The dry sulfur should be thoroughly dusted over the foliage in an effort to hit all the spiders. It is best to apply sulfur when the foliage is moist with dew. Hydrated lime mixed in equal parts with the sulfur will make it more adhesive. Sulfur becomes effective only when the sun vaporizes it; so if applied when the sun is not shining it will remain inactive until the first bright day.

REPELLENTS.

A repellent is any material which is applied to a plant or animal that may be of service in driving away any insect that might attack it. Dry air-slaked lime is of service in driving away some pests. It should be dusted directly onto the insects which are feeding upon the plant. Tobacco dust acts as a repellent to some insects, especially the root-feeding insects. Naphthalene flakes or moth balls act as a repellent for insects that infest stored products. Bordeaux mixture, a fungicide, acts as a repellent for many insects, especially for some forms which feed upon potatoes and tomatoes. The various fly sprays which are applied to stock merely act as repellents.

Protective Tree Washes.

1. Dissolve one pound of hard soap in three gallons of water. Add one-half pint of crude carbolic acid and two ounces of Paris green. Then add enough lime to make a thick paste, such as will be easy to apply to the trees.

2. Dissolve sixteen pounds of hard soap in eighty gallons of boiling water. Then add two quarts of crude carbolic acid and enough freshly slaked lime to make a thick paste.

3. Slake one bushel of lime in a small quantity of warm water. Add ten pounds of sulfur, which has been previously made into a paste. Then add one-half gallon of *gas*-tar and dilute with water to fifty gallons.

4. Dissolve seventy pounds of quick lime in fifty gallons of water. Add six pounds of caustic potash and two and one-half pints of crude carbolic acid.

These washes should be painted on the trunks and lower limbs of the trees, and the application should be very thorough to be effective. Every small crevice in the bark should be well coated with the wash. Unless rains occur immediately after the application is made, two or three applications will be sufficient during the summer.

Fly Repellents.

There are a great many home-made and proprietary external remedies for repelling flies from stock. Many of them have a value, but many more are of no service whatsoever. The most common defect of many of the repellents is the very short period during which they are effective. Some repellents are undoubtedly poisonous and should be used with extreme care. The qualities to be sought in a satisfactory repellent are absence of toxic or other detrimental properties, a decided repellent action on the flies, and a long period of effectiveness. The following have given satisfactory results over the country:

No. 1. The Moore formula:

Fish oil	100 parts.
Oil of tar	50 parts.
Crude carbolic acid	1 part.

The cost of this material should not be over 35 cents per gallon. This mixture is safe when applied lightly with a brush, and the repellent action is usually effective for three days.

No. 2. The Bishopp formula:

Fish oil	1 gallon.
Oil of tar	2 ounces.
Oil of pennyroyal	2 ounces.
Kerosene	1 pint.

This mixture is very effective in keeping flies from live stock when applied lightly with a brush.

No. 3. The Parrott formula:

Fish oil	2 quarts.
Crude carbolic acid	1 pint.
Oil of pennyroyal	1 ounce.
Oil of tar	8 ounces.

Kerosene sufficient to make one gallon of the mixture.

The cost of this is given at 80 cents a gallon. It must be applied with a hand atomizer and not with a brush.

FUMIGANTS.

Fumigation is available only for insects that can be treated in an enclosed space. This method is good for the treatment of pests which attack stored products and for greenhouse pests.

Carbon Bisulphide.

This material is most extensively used against insects which attack stored products. Household goods may be fumigated with this material if the proper precautions are taken. It is used to some extent for root-feeding insects by injecting it into the soil. Carbon bisulphide is a clear, yellow liquid with a very strong and disagreeable odor. When exposed to the air it evaporates very quickly and the fumes being heavier than air go to the bottom of the enclosed space. The fumes are not so effective below temperatures of 60° F. and a larger dose is required under such conditions. Any material to be fumigated should be placed in as small a space as possible, since it is the confined area and not the contents that determines the dosage. The bisulphide should always be put in shallow dishes and placed on top of the material that is to be fumigated. The amount of bisulphide necessary for a single application varies considerably according to the insect that is to be killed. One pound to a thousand cubic feet is sufficient for many insects, but as much as ten pounds is required for others.

Do not allow any fire or source of fire, as a lighted cigar, to be near the fumigation or the stored bisulphide. The fumes from carbon bisulphide are highly inflammable and under certain conditions explosive. Use the same precaution in handling this material that would be used in handling gasoline. The fumes should not be inhaled as they cause a suffocation which results in dizziness.

Sulfur.

The fumes of burning sulfur have long been recognized as a standard remedy for the fumigation of dwellings. It is an excellent remedy for bedbugs in empty houses. The serious objections to the use of sulfur fumes are: they will bleach fabrics; they will tarnish brass; they will destroy vegetation, and they will destroy the germinating power of seeds.

Tobacco.

For fumigating greenhouses tobacco fumes are universally used. This material can be employed where the most tender plants are grown, and it is especially effective in controlling plant-lice. Many outdoor plants, as melons and low shrubs or trees, may be fumigated with tobacco fumes by means of specially constructed covers. The methods of fumigation are to burn tobacco stems, or dust, or to vaporize some of the liquid

extracts, or to burn some of the punk papers now for sale. This last method is most satisfactory as it is possible to designate the proper amount of paper to be furned in a given confined space.

Hydrocyanic Acid Gas.

This is the most active fumigant known. It is made by combining water, sulphuric acid, and potassium cyanide. This gas is a deadly poison to all plant and animal life, and it should not be used unless the operator has had experience or unless proper directions are carefully followed.

SPRAYING MACHINERY.

The question is often asked: "What kind of pump shall I buy?" The beginner has but one aim in the purchase of a sprayer and that is to get as cheap an outfit as possible. The poor results obtained by the use of such an outfit are discouraging. It is economy to buy the best grade of pump of the size deemed advisable to use. In general, it may be said that in the purchase of a spraying outfit care should be taken to select only one that seems durable, simple, and of ample capacity. The various classes of pumps are here briefly described.

PUMPS.

The simplest type of spray pump is that made to use in a bucket. An example of this class of pump is shown in Figure 3. A good bucket pump should have a large air chamber so that a steady pressure may be maintained. The pump should be fitted with a long hose, at least fifteen feet, and an extension rod of four feet. This class of pump is adapted for use in the small home garden, for spraying a few small trees, or for spraying poultry houses and stalls. The better grade of pumps properly equipped cost about $5.00.

The principal disadvantage of this class of pump is that one cannot work rapidly, since it is necessary to move the bucket frequently and to refill with spray liquid often. It is not always easy to work the pump and properly direct the spray at the same time.

Compressed Air Sprayers.

This class of sprayer is quite popular for use in small gardens. The pumps are easily carried and leave both hands free to direct the spray material. The chief objections to this class of pumps are: they require frequent pumping to maintain sufficient compressed air for proper pressure; there is no agitator to enable proper application of the poisonous spray; and they are not easily filled. The better grades of this class of pump cost from $5.00 to $8.00.

Barrel Pumps.

The barrel pump is the most serviceable and satisfactory outfit to purchase for use on the average farm. With this type of pump it is

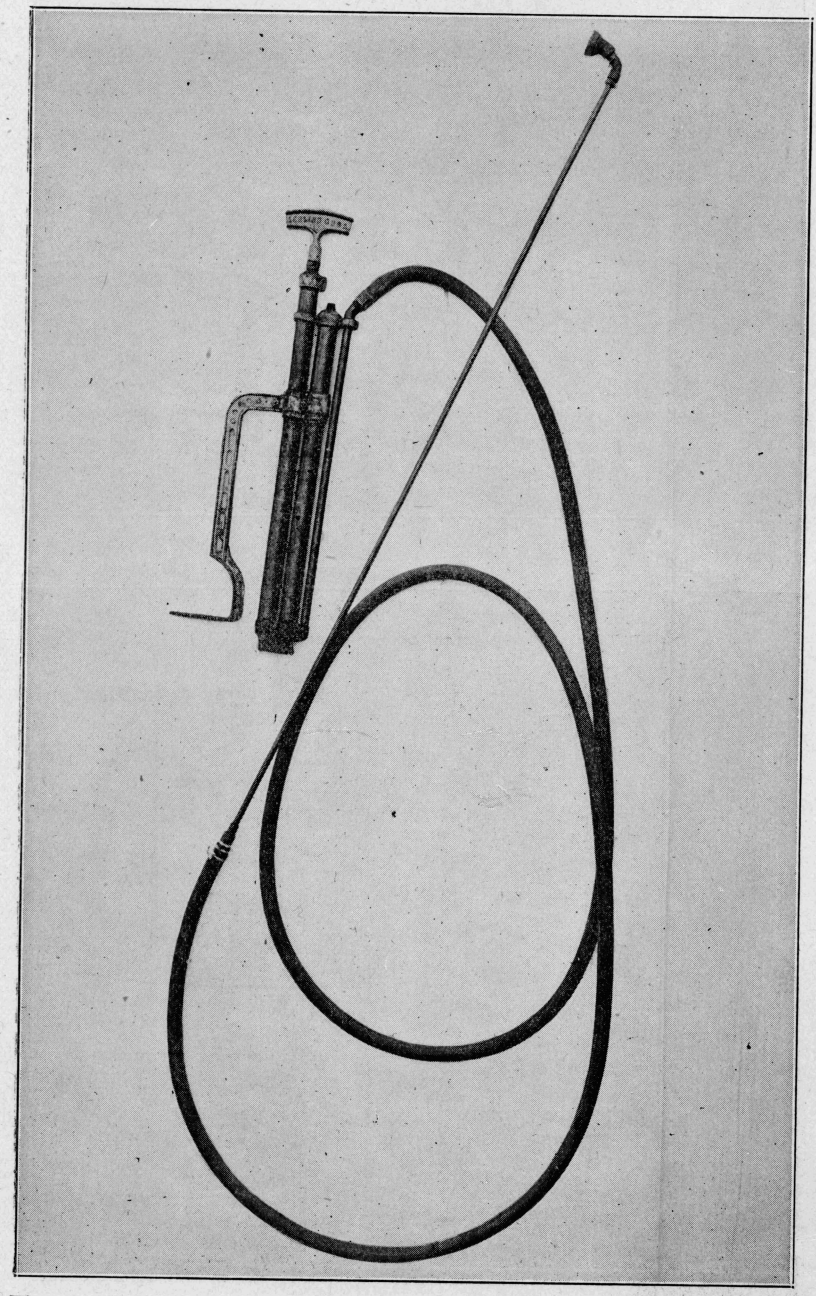

Fig. 3. A bucket pump properly equipped for general use. (Texas Sta. Bull. 180.)

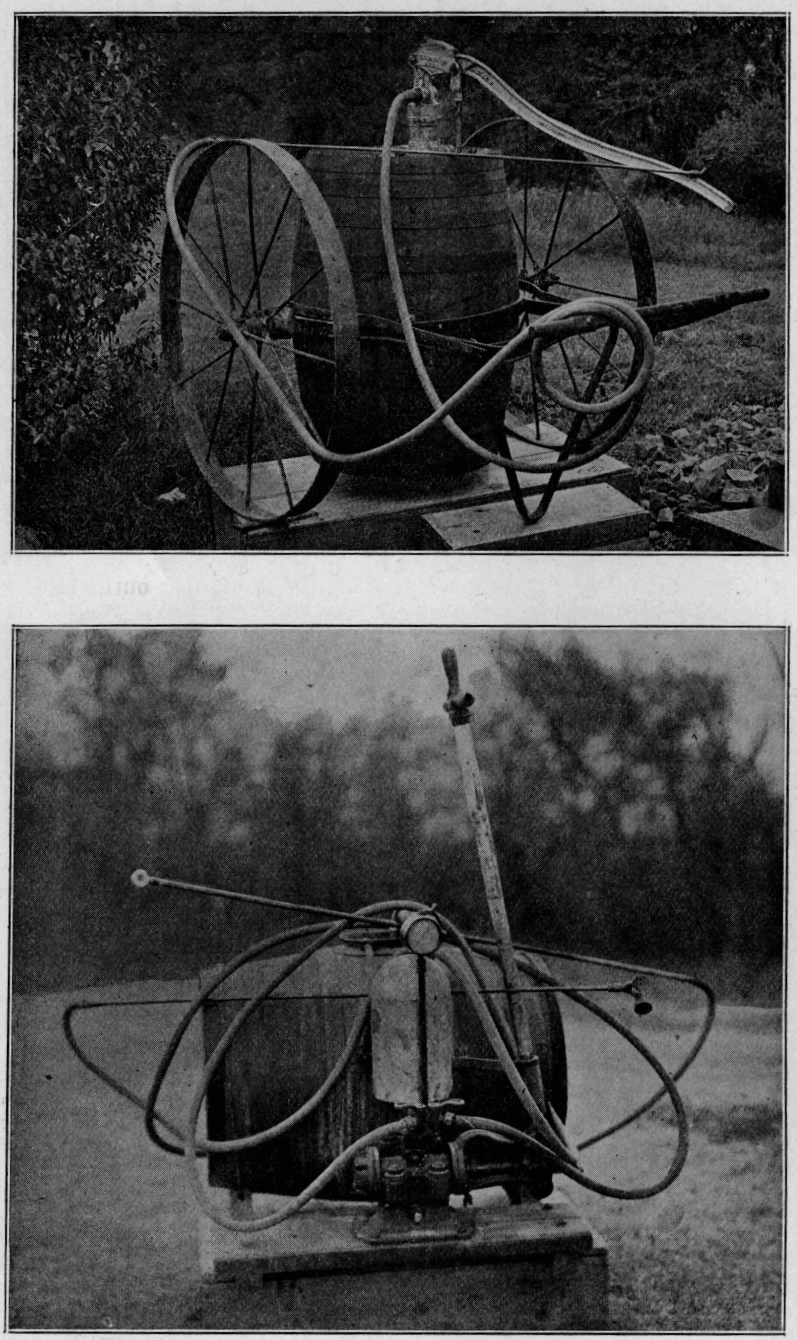

Fig. 4. Above, a barrel spray pump; below, a hand power pump. (Texas Sta. Bull. 180.)

possible to spray a small young orchard, and with a row attachment it is possible to spray a few acres of truck crops. A good barrel pump should supply two leads of hose; so it is possible to spray rapidly with this outfit. The following points should be considered in selecting a barrel spray pump:

1. The pump should be guaranteed to supply material at 100 pounds pressure on two leads of hose.
2. It should have a large air chamber within the barrel and not projecting above.
3. The valves, plunger, and cylinder should be made of brass. The other parts of the pump should be made of malleable iron.
4. There should be but few working parts of the pump above the barrel.
5. The pump should be so attached to the barrel that it can be quickly removed for repairs.
6. The pump should have a good mechanical agitator.

Usually the barrel pump is mounted directly on a fifty-gallon barrel which serves as a supply tank. This outfit is placed in a wagon or hauled about on a sled for spraying. A good example of a barrel pump is shown in Figure 4. The cart shown in this figure is made especially for barrel pumps, but it is not included in the regular outfit and it is not necessary to purchase this cart.

Horizontal Hand Pumps.

These pumps are double acting and furnish more power than the barrel pump; so it is possible to spray much faster. The pumps may be mounted to use a barrel as a supply tank, but are usually mounted on a 100 or 150-gallon tank. This class of pump will maintain a pressure of 100 to 125 pounds on four or eight nozzles. In efficiency this class of pump is equal to the smaller power outfits. For extensive truck crops and for the ordinary small orchard spraying, this outfit is the best one to purchase. The pump, without any supply tank or accessories, will cost from $22.00 to $25.00. In Figure 4 an example of this class of pump is shown which is mounted to use a barrel as a supply tank.

Power Pumps.

For very extensive spraying a power sprayer outfit is most economical and with it a great amount of spraying can be quickly done. The gasoline outfits have given the most satisfactory results. Such an outfit usually consists of a gasoline engine, a heavy pump of two or three cylinders, which is connected to the engine, and a large supply tank. The entire outfit is mounted on heavy special trucks. These outfits cost from $200.00 to $400.00. Figure 5 shows an example of this class of pump.

Dust Sprayers.

For applying insecticides in the powdered form it is possible to obtain several types of spray machines or dust guns. These are usually

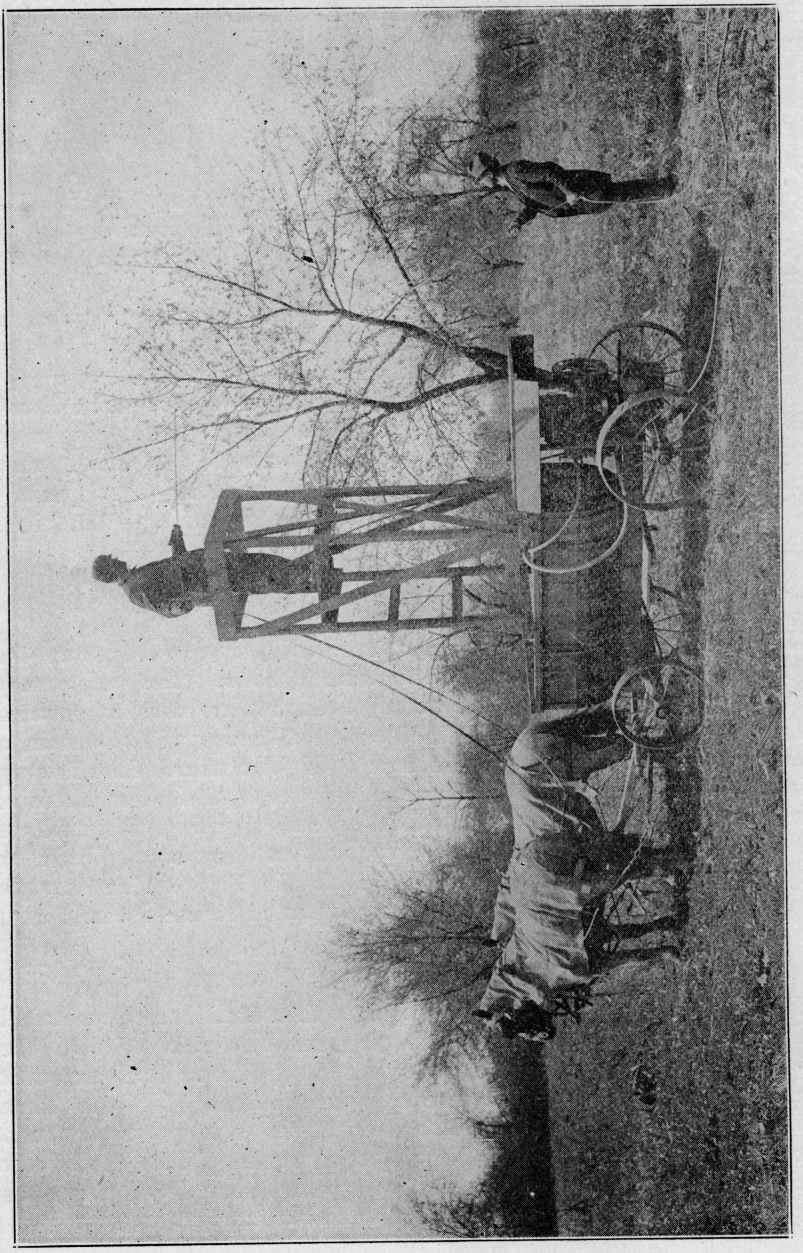

Fig. 5. A gasoline engine power spray outfit. (Ind. Cir. 34.)

designed to be carried by hand and the powder is blown from the container by means of a revolving fan. Under suitable conditions it is possible to do quite rapid work with a dust gun, and this work is often efficient. It is possible to regulate the amount of poison that is applied to the plants. These dust guns are especially adapted for applying material, such as powdered arsenate of lead, to truck or field crops, primarily cotton. A common type of dust gun is shown in Figure 6.

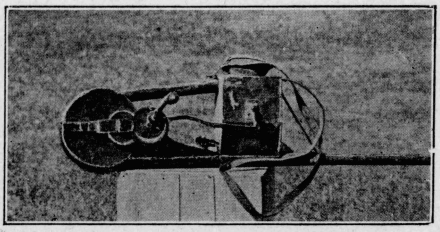

Fig. 6. A powder gun or dust sprayer. (O'Kane.)

ACCESSORIES.

Nozzles.

There are a great variety of styles of spray nozzles on the market, but only three types are in common use. These are the Bordeaux, Vermorel, and Disc type, shown in Figure 7.

The Bordeaux Nozzle.—The Bordeaux nozzle is one of the old types, but is still in use on the smaller outfits. It has an adjustable opening which can be arranged to throw a fan-shaped, semi-solid stream or a fine spray. This nozzle is entirely unsuited for orchard work but is well adapted for row spraying of truck crops.

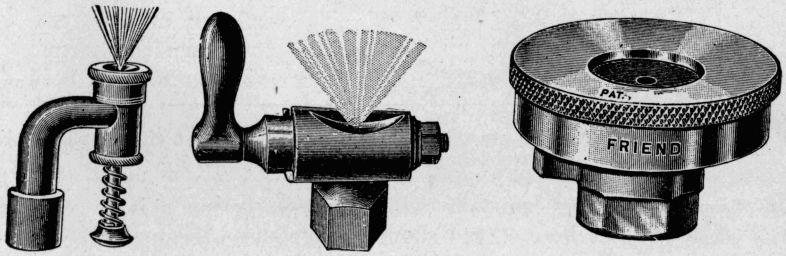

Fig. 7. Three types of spray nozzles in common use. (Sanderson.)

Vermorel Nozzle.—This type of nozzle throws a mist-like spray. It is adapted for use on the hand outfits, but is too slow for extensive spraying. It invariably clogs in a short time and requires frequent cleaning. There are some modifications of the Vermorel nozzle now on the market which have overcome some of the undesirable features. This nozzle is often used on the row attachments for spraying truck crops.

The Disc Nozzle.—This type of nozzle was evolved from the Vermorel. It is a most desirable type of nozzle for general spraying and will operate under a heavy pressure. These nozzles do not clog easily, do not catch on the twigs of trees and shrubs, are light, and reduce time in spraying. There are several modifications of this type of nozzle, and one should attempt to purchase the nozzle of simplest construction.

Extension Rods.—These are necessary in spraying trees to elevate the nozzles to a point where the spray can reach the upper parts of the tree. A short extension rod is necessary in spraying truck crops, in order that the nozzle may be placed so as to properly direct the spray material. There are two types of extension rods: the small iron or brass rod and the bamboo pole with the pipe inside.

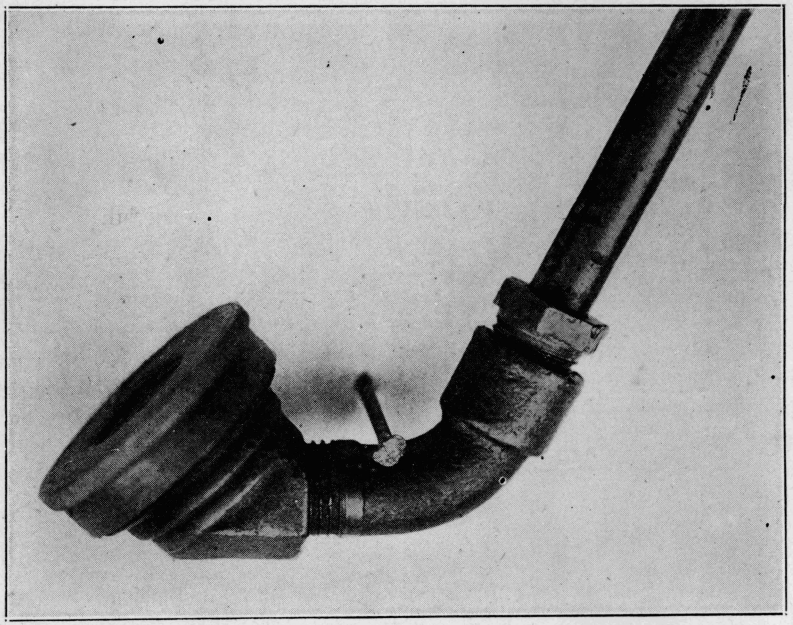

Fig. 8. A nozzle attached to an extension rod by means of an elbow; the proper equipment for underspray. (Original.)

Hose.—The common mistake which is usually made is to purchase too short a lead of hose. One should never purchase under a 15-foot lead for the smallest hand outfit, and for the larger outfits a 25-foot lead of hose will be found quite satisfactory. One should never purchase under a 3-ply, and it will be found that a 5-ply will last much longer and give much better results.

Strainer.—A good strainer is an essential part of any spray outfit. There is considerable sediment in most of the spray materials and this must be removed if the pumps are expected to last and the nozzles to work properly.

Cautions.

1. The chemicals used in spraying should be kept in tight jars which are correctly labeled and out of the reach of children.
2. Sprays recommended for the dormant season should never be used when the trees are in leaf.
3. Never spray when trees are in full bloom. Spray just before the buds open or after the flowers have fallen. To spray trees in full bloom will destroy bees, which are necessary to fertilize the flowers.
4. Spraying is largely preventive and should be done at the proper time. To be most effective the spray should be applied before or when the insect starts to feed.
5. All parts of the tree should be thoroughly covered with the spray solution.
6. If a rain occurs soon after an application of spray the process should be repeated.
7. Do not apply a liquid spray when the foliage is wet.
8. When spraying a lime-sulfur wash use a wooden supply tank.
9. When quick lime is required in a formula only the best freshly burned stone lime should be used. Air-slaked lime will not serve the purpose.
10. Spraying should be done *intelligently* to be successful.

PREVENTIVE MEASURES.

One excellent authority has said that "Four-fifths of the insect injury may be prevented by a better sytem of agriculture." For that reason it seems advisable to mention briefly a few of the more important methods by which insect injury may be reduced by farm practices.

Crop Rotation.

One of the most important farm methods is crop rotation. If carried out properly it is not only a great benefit to the land, but is one of the best means of reducing injury by insects. In many cases a yearly rotation will be found advantageous, while a frequent rotation will always be found beneficial. The corn root worm may be entirely controlled by a rotation in which corn is never grown two successive years on the same land. Where this pest is present corn may be followed by small grain or grass. Corn should not follow cotton on land where the boll worm has done serious injury. As this insect attacks several plants great care is necessary to select suitable land for planting the susceptible crops. Tomatoes should never be planted close to corn, as the boll worm will increase on corn to attack the tomatoes. A frequent rotation will often materially reduce injury by the chinch bug. Small grains should not follow on land where corn has suffered from the chinch bug. The leguminous crops, as the cowpeas, are of much importance in rotation, as they are not usually attacked by the insects affecting other crops. Rotation of crops is practically the only means

of dealing with most of the injurious insects, especially the staple-crop pests.

Diversified Agriculture.

Entire plantings of crops are very often failures because the growers rely upon a single, or perhaps two crops for a living. The practice of growing large areas of cotton may be taken as an example of this. In Texas there was danger at one time that the growing of cotton would be abandoned, owing to the ravages of the boll weevil. Of late years in the South corn has been varied with cotton, but both of these crops are injured by the same insect—the cotton boll-worm or the corn-ear worm. In some sections of the United States the farmer does not have such problems to contend with, as several kinds of crops are raised. The time will come in this State when diversified farming will become an absolute necessity to combat many of the more injurious insect pests.

Fall Plowing.

One of the best means of reducing injury from those insects which spend a portion of their life in the soil is fall plowing. This farm operation is of great value in forming a good seed bed and in conserving soil moisture. The process may be varied by harrowing, discing, and raking. The object of fall plowing is to bring the insects to the surface of the ground, where they will be exposed to the weather and to their natural enemies, as domestic and wild birds, and mammals. This method is very valuable to prevent the recurrence of insect attack, and it is beneficial for most forms of insects which hibernate under or near the surface of the ground in open fields, meadows, and similar places. It is particularly valuable to crops that are subject to injury by the white grub, root worms, wire-worms, cutworms, and grasshoppers. Fall plowing should be practiced wherever it does not interfere with other methods of crop management. Discing may be used in meadows or on alfalfa to obtain the same results.

Seasonal Cultivation.

Cultivating during the season is a very valuable aid in the destruction of injurious insect pests. The ear-worm of corn, or the boll-worm of cotton, spends part of its life just beneath the surface of the soil, and if cultivation can be given at the time coincident with this period many of the insects will be brought to the surface and killed. The plum curculio goes into the ground to transform, and at this time is easily killed by cultivation.

Clean Farming Methods.

The most valuable of all methods for the control of injurious insects is clean farm practice. It is more or less a safeguard against the majority of insects that ravage the crops. Clean methods are advisable against most insects, and are an absolute necessity against those insects which injure fall crops, as such insects pass the winter in the rubbish

in and about the fields. The fence rows and the waste places should be burned or disturbed in some manner in the fall. Weeds should never be allowed to grow on the farm, as they only harbor insect pests until cultivated crops are in condition to be attacked. Crop remnants should not be allowed to remain in the field. One of the most important means of combating the cotton boll weevil is the destruction of the stalks in the fall as soon as the cotton can be picked. In this way the food of the weevils is removed and they are starved before time to hibernate and there is little or no shelter left to protect the few living ones during the winter.

Trap Crops.

Trap crops are those which are planted as a bait or a lure to attract insects early so that they may be destroyed before the main crop is available. Doubtless the reason that trap crops are not more generally used is that to be successful with them it is necessary to know the life history and habits of the pest to be combated. If the cabbage patch has become infested with the Harlequin cabbage bug, it is a very difficult matter to destroy this insect, but if a crop of kale is planted the previous fall the bugs which hibernate over the winter will attack it in spring, when they can be killed or the plants destroyed. Radishes are sometimes used as a trap crop for root maggots, which affect cabbages and onions. One of the most successful examples of preventing insect injury by the use of a trap crop is seen in the practice of planting corn to protect cotton from the ravages of the boll worm. A few strips of late maturing corn should be planted at intervals through the cotton. This corn will come into silk about the time a brood of moths appear, which would, ordinarily, lay their eggs on cotton, but prefer the corn. After the worms are found, the corn should be cut and fed to stock. This method is also very useful in protecting tomatoes from the same insect.

Selection of Place and Time for Planting.

Much depends upon a judicious selection of the crop to replace weeds, or to be grown on new land, or in land that has long laid waste. Unfortunately the crops frequently selected for planting in new land are the very ones most subject to insect attack. Corn, cereals and potatoes should not be planted as the first crop on new land; nor should such crops as corn be planted as a first crop in marshy tracts. Under such conditions wire-worms, white grubs, and cutworms are likely to prove very injurious.

Next in order is the choice of the proper time to plant a crop to avoid injury. An early variety of cotton planted early and cared for properly is said to suffer less from the attacks of the boll weevil. In addition to a very early planting and a very late planting, some crops must be planted so as to come between two generations of an insect. Late planting is a standard remedy against a great many insects. The stalk borer does less damage to late planted corn.

The Maintenance of Vigorous Growth.

Plants may become weakened from one cause or another and, as a general rule, such plants are more liable to insect injury. Cases have been noted where the liberal use of nitrate of soda prevented destruction by wire-worms. Entomologically speaking, commercial fertilizers are generally more desirable to improve plant growth than is barnyard manure. This is due to the fact that many insects spend a part of their life in manure and they may be spread when the manure is put on the field. Many times, however, barnyard manure will more than make up for the loss which may come in this way. Very often plants, by proper attention, may be made to outgrow insect injury.

Burning.

This practice is particularly valuable against such insects as hibernate on or in the soil. Among the well-known pests that can be reached by this method are the boll weevil, cutworms, garden web worms, army worms, grasshoppers, chinch bugs, lice, and Harlequin cabbage bugs.

Farm Inspection.

The fact that the greatest injury is often accomplished before the presence of the insect is detected proves the value of prompt action in the treatment of the crops attacked. Frequently the attack is unnoticed until the damage is beyond repair, and this might have been averted if the grower had employed some of the farm practices. As soon as a crop is planted it should be inspected for signs of injury, and backward plants should receive special attention. As insect attacks usually begin on the border of the field they may be detected by simply walking around the field. Preventive work, such as fall plowing, rotation and clean farming, should be instituted as a part of the routine farm operations.

From the above remarks it is evident that the prevention of insect injury does not necessarily depend upon the application of poisons, but the prevention is in the hands of the grower himself to a very large extent. It is hoped that these suggestions will be of some benefit in devising means of reducing insect injury to farm crops in the future.

WHERE INSECTICIDES AND SPRAYING MACHINERY CAN BE OBTAINED.

As it is necessary to recommend the use of insecticides and spraying machinery for the control of insects, and as many farmers and fruit growers do not know where these things can be secured, the following list of manufacturers of, and dealers in, these supplies has been prepared. The prospective buyer may write to any of them for catalogues and prices:

Spraying Machinery.

Bering-Cortes Hardware Company, Houston, Texas.
E. H. Caldwell & Son, Corpus Christi, Texas.

Reichardt & Schulte Company, Houston, Texas.
San Antonio Drug Company, San Antonio, Texas.
Texas Seed and Floral Company, Dallas, Texas.
American Sprayer Company, Minneapolis, Minn.
Aspinwall Manufacturing Company, Jackson, Mich.
Barnes Manufacturing Company, Mansfield, Ohio.
Bateman Manufacturing Company, Greenloch, N. J.
Bean Spray Pump Company, Cleveland, Ohio.
Binks Spraying Machine Company, Chicago, Ill.
Brandt Manufacturing Company, Hastings, Minn.
E. C. Brown Company, Rochester, N. Y.
Champion Manufacturing Company, Pontiac, Mich.
Cushman Sprayer Company, Lincoln, Neb.
Dayton Supply Company, Dayton, Ohio.
Deming Company, Salem, Ohio.
R. H. Deyo & Co., Binghamton, N. Y.
W. & B. Douglas, Middleton, Pa.
Dust Sprayer Sales Company, Kansas City, Mo.
Fairbanks, Morse & Co., St. Paul, Minn.
Field Force Pump Company, Elmira, N. Y.
Friend Manufacturing Company, Gasport, N. Y.
Gilson Manufacturing Company, Port Washington, Wis.
Goulds Manufacturing Company, Seneca Falls, N. Y.
U. S. Grant Power Sprayer Company, Winchester, Va.
Griffith & Turner, Baltimore, Md.
Hardie Manufacturing Company, Hudson, Mich.
Hurst Manufacturing Company, Canton, Ohio.
International Harvester Company, local agencies.
Latham & Co., Sandusky, Ohio.
Leggett & Brother, New York City, 301 Pearl St.
Morrill & Morley, Benton Harbor, Mich.
F. E. Myers & Bro., Ashland, Ohio.
The New Way Motor Company, Lansing, Mich.
Niagara Sprayer Company, Middleport, N. Y.
Olds Gas Power Company, Lansing, Mich.
Pierce Loop Company, Northeast, Pa.
Splittstosen Manufacturing Company, North Branch, Minn.
Spraymotor Company, Buffalo, N. Y.
Wm. Stahl Sprayer Company, Quincy, Ill.

Arsenate of Lead (Paste Form).

Ansbacker & Co., New York City, 253 Broadway.
Bowker Insecticide Company, Boston, Mass.
Jas. Bute Company, Houston, Texas.
Grasselli Chemical Company, New Orleans, La.
Henry Heil Chemical Company, St. Louis, Mo.
Hemingway & Co., New York City, 17 Battery Place.
Jacksonville Drug Company, Jacksonville, Texas.

Merrimac Chemical Company, Boston, Mass.
B. G. Pratt Company, New York City, 50 Church St.
Reichardt & Schulte Company, Houston, Texas.
San Antonio Drug Company, San Antonio, Texas.
Sherwin-Williams Company, Dallas-Houston, Texas.
Southern Drug Company, Houston, Texas.
Texas Seed and Floral Company, Dallas, Texas.
Thomsen Chemical Company, Baltimore, Md.

Arsenate of Lead (Powdered).

Ansbacker & Co., New York City, 253 Broadway.
Corona Chemical Company, Milwaukee, Wis.
Grasselli Chemical Company, New Orleans, La.
Henry Heil Chemical Company, St. Louis, Mo.
Hemingway & Co., New York City, 17 Battery Place.
Jacksonville Drug Company, Jacksonville, Texas.
B. G. Pratt Co., New York City, 50 Church St.
Reichardt & Schulte Company, Houston, Texas.
San Antonio Drug Company, San Antonio, Texas.
Sherwin-Williams Company, Dallas-Houston, Texas.
Thomsen Chemical Company, Baltimore, Md.

Whale Oil Soap (Fish Oil Soap).

Baker Brothers, Fort Worth, Texas.
James Good, Philadelphia, Pa., 939-941 N. Front St.
Reichardt & Schulte Company, Houston, Texas.
San Antonio Drug Company, San Antonio, Texas.
Starley Drug Company, Tyler, Texas.
J. Steckler Seed Company, New Orleans, La.
Texas Seed and Floral Company, Dallas, Texas.

Pyrethrum.

San Antonio Drug Company, San Antonio, Texas.
Southern Drug Company, Houston, Texas.
Texas Seed and Floral Company, Dallas, Texas.

Crude Oil and Road Oil.

Gulf Refining Company, offices in all principal Texas cities.
Magnolia Petroleum Company, offices in all principal Texas cities.
The Texas Company, offices in all principal Texas cities.

Tobacco Dust, Stems, Soaps, Extracts, Tobacco Paper, Etc.

Aphine Manufacturing Company, Madison, N. J.
Baker Brothers, Fort Worth, Texas.
Deutsch Brothers, New York City, 1399 Avenue A.
David Hardie Seed Company, Dallas, Texas.

Kentucky Tobacco Products Company, Louisville, Ky.
Reichardt & Schulte Company, Houston, Texas.
Southern Drug Company, Houston, Texas.
Texas Seed and Floral Company, Dallas, Texas.

Concentrated Lime-Sulfur Solution.

Bowker Insecticide Company, Boston, Mass.
Corona Chemical Company, Milwaukee, Wis.
Grasselli Chemical Company, New Orleans, La.
B. G. Pratt Company, New York City, 50 Church St.
Sherwin-Williams Company, Dallas-Houston, Texas.
Thomsen Chemical Company, Baltimore, Md.

Soluble Sulfur.

Niagara Spraying Company, Middleport, N. Y.

Sulfur.

Batelle & Renwick, New York City.
Bergenport Sulfur Works, New York City.

Carbon Bisulphide ("High Life").

Taylor Chemical Company, Penn Yan, N. Y., is manufacturer.
San Antonio Drug Company, San Antonio, Texas.
Southern Drug Company, Houston, Texas.

Paris Green.

Can be secured from druggists and merchants in practically all localities.

Formaldehyde.

Perth Amboy Chemical Works, 50 Church Street, New York City, take particular interest in formaldehyde for agricultural uses and issue an interesting free booklet concerning it. Obtainable from druggists generally.

Stock Dips, Poultry Remedies and Disinfectants.

Henry J. Bering, Houston, Texas, 304 Prairie St.
Crowdus Bros. & Co., Dallas, Texas.
G. W. Huth Seed Company, San Antonio, Texas.
Parke, Davis & Co., Kansas City, Mo.
San Antonio Drug Company, San Antonio, Texas.
Texas Drug Company, Dallas, Texas.
Zenner Disinfectant Company, Detroit, Mich.

DIRECTIONS FOR SENDING INSECTS TO THE STATE ENTOMOLOGIST.

When sending insects for determination, send living specimens in a strong *wooden* or *tin* box by mail. No openings are necessary to admit air. Whenever possible, enclose some of the food-plant for the insects to subsist on en route; specimens showing the injury done are most desirable.

Do not send insects in envelops or pasteboard boxes; they are invariably crushed beyond beyond recognition and, besides, there is danger of their escaping en route and infesting the fields or orchards of others, the *sender* being thereby rendered *responsible for damages.*

The *name and address* of the *sender* should be plainly written on every package.

It is *against the postal regulations* to enclose a letter in a box by mail unless sent at letter-postage rate.

Specimens of caterpillars, worms, etc., *in alcohol or other liquid,* can be sent by mail *only when in regular mailing tubes.*

We shall be greatly aided in giving reliable advice if correspondents writing about insect pests will give as full description of the habits, food plants, injury, etc., as possible.

Specimens of twigs, living plants with foliage, etc., should be wrapped in damp (not wet) cotton cloth, so as to reach us in fresh condition.